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(19)

## (54) IMPROVEMENTS IN AND RELATING TO HYDRAULIC MOTORS

(71) We, ARMSTRONG PATENTS Co. LIMITED, a British Company, of Bucklersbury, House, Bucklersbury, London, E.C.4. do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns hydraulic motors and relates more particularly to double-acting motors such as hydraulic jacks and rams.

Hydraulic jacks and rams are used in various applications where loads such as vehicle bodies or vehicle cabs are required to be lifted or tilted.

According to the present invention there is provided a hydraulic motor arrangement comprising a double-acting hydraulic piston and cylinder device connected by a pair of hydraulic lines to a pump unit, said piston and cylinder device embodying a pair of fluid flow restrictors connected one in each hydraulic line, and a reversing valve integral with the pump unit for directing the flow of hydraulic fluid from the pump unit to the piston and cylinder device through a preselected one of said hydraulic lines.

The pump unit may be provided with a hydraulic fluid from the pump unit through thickened portion in its base, the thickened portion having a bore therein which serves to receive a rotary valve member forming said reversing valve.

The rotary valve member may have an axial bore therein in which is placed a valve ball resiliently biased against a co-operating valve seat circumscribing a pressure relief passage formed in the valve member between the axial bore and a circumferential recess in the valve member.

A reservoir for holding a supply of hydraulic fluid may also be formed integral with the pump unit if desired.

Conveniently, one of said hydraulic lines has a branch constituting or connected to a closed hydraulic chamber having a volumetric capacity less than that of said piston and cylinder device and an isolating valve operable to isolate said line and said branch from the remainder of the circuit whereby the extent of movement of said device towards the end position corresponding to the isolated line is limited by the volume of hydraulic fluid that the closed chamber is able to accept from said device.

The hydraulic chamber may conveniently be made of variable volume, thereby enabling the extent of movement of the piston and cylinder device to be preselected within the limits of the chamber adjustment.

The invention will be described further by way of example with reference to the drawings accompanying the Provisional Specification:—

Fig. 1 is a schematic circuit diagram of a hydraulic ram system embodying the invention;

Fig. 2 is a vertical section elevation of a preferred form of hydraulic displacement chamber;

Fig. 3 is a section taken on a vertical plane through a pump unit employed in the invention;

Fig. 4 is a section taken on the line IV-IV of Fig. 3; and

Fig. 5 is an axial section through part of a ram.

In the hydraulic ram system shown in Fig. 1 a double-acting hydraulic ram generally designated 10 is connected by hydraulic lines 14 and 16 to a changeover valve or reversing valve 18 incorporated in a hydraulic pump unit 24, the hydraulic lines 14 and 16 being connected to opposite end regions of the ram cylinder 12. The valve 18 has an inlet port 20 which is connected by a further hydraulic line 22 to the delivery side of a hydraulic pump 25 of the pump unit 24.

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Valve 18 also has an outlet port 26 which is connected by hydraulic line 28 to a reservoir 30 of the pump unit 24 and from which the pump 25 draws hydraulic fluid. A blow-off valve or pressure relief valve 32 in pump unit 24 is connected between the delivery side of the pump 25 and the reservoir 30. It will be noted from Fig. 1 that the hydraulic lines 14 and 16 are connected to itermediate ports 21 and 27 respectively of the valve 18.

A preferred pump unit for use in the circuit illustrated in Fig. 1 is shown in Figs. 3 and 4 and will be seen to comprise a body member 60 formed towards one end with a pump cylinder 62 and towards the opposite end with a reservoir chamber 64 which is open at the top of the body member 60, the upper opening being closed by an inverted cup-shaped cap or cover 66. The pump cylinder communicates at its bottom end through suction bores (not shown) in the body member 60 and by way of an inlet valve 68 with the reservoir 64. Within the cylinder 62 there is a slidable piston 70 formed at one end of a piston rod 72 which extends out of the body member for reciprocation by crank means, a part of which is generally indicated at 74. The piston will be seen to have its free inner end axially bored to receive a non-return valve assembly 76 by which hydraulic fluid is enabled to pass from the cylinder space in front of the piston to the cylinder space behind it by way of a port 78. It will be noted that the pump is double-acting responsive to reciprocation of the piston rod 72, in that, during outward strokes of the piston in the cylinder, whilst hydraulic fluid is being drawn into the cylinder space in front of the piston, further fluid which has previously passed through the piston is displaced from the cylinder space behind it and through suitable bores in the pump body to a delivery port (not shown); whilst, during inward strokes of the piston, not only does the hydraulic fluid previously draw in into the cylinder space in front of the piston then pass through the piston by way of the valve 76 and port 78 but there is simultaneous differential displacement of hydraulic fluid from the cylinder space behind the piston due to the volume of the piston rod which enters that cylinder space during the inward stroke.

As more clearly evident from Fig. 4, the body member 60 of the pump unit 25 is provided in its base region with a thickened portion generally designated 80. The thickened base portion 80 is formed with a bore 82 which opens into the front of the body member 60 and which serves to receive a rotary valve member 84 having a front portion extending within body member 60 and fitted with a handle 86 enabling the valve member 84 to be rotated within the bore 82. The valve member 84 is provided intermediate its ends with a pair of circumferentially extending and diametrically opposed recesses 88 and 90. The recess 88 is in permanent communication with the port formed in body member 60 and leading to the delivery side of the pump and the handle 86 is arranged to permit rotation of the valve member 84 between a pair of end positions, in one of which the recess 88 delivers pressure fluid from the pump to a hydraulic line corresponding to the line 16 of Fig. 1, for the purpose of raising the ram 10 and in the other of which it delivers pressure fluid from the pump to a line corresponding to the line 14 of Fig. 1 in order to lower the ram. The recess 90 of valve member 84 is in permanent communication with a passage 92 formed in the pump body member 60 and leading to the reservoir 64, the arrangement being such that in the first position of the handle 86 the recess 90 permits hydraulic fluid to return from the ram along the line 16 of Fig. 1 and hence back to the reservoir 64 and in the second position of the handle 86 hydraulic fluid is similarly permitted to return to the reservoir 64 from the line 14 in Fig. 1. In order to prevent incorrect operation of the pump in a circuit such as that such in Fig. 1, the pump unit 25 is provided with a pressure relief valve by forming the valve member 84 with an axial bore 94 wherein is arranged a valve ball 96 resiliently biased against a co-operating valve seat circumscribing a pressure relief passage 98 formed in valve member 84 between the bore 94 and the circumferential recess 88. The resilient loading of the valve ball 96 is exerted by a spring 100 retained in the bore 94 by a hollow screw 102. The valve member 84 in turn is retained in the bore 82 by means of a washer 104 secured by a circlip 106. In this way the valve member 84 is readily removable from the body member 60 and permits simple replacement of the pressure relief valve merely by unscrewing the retaining screw 102 and substituting a different spring 100.

As will be appreciated, the pump unit illustrated in Figs. 3 and 4 incorporates in a single assembly the several components diagrammatically illustrated within the dotted line 24 of Fig. 1 and thus provides at a single location, the facilities both of pumping and of adjusting the delivery of hydraulic fluid in order to selectively operate a double-acting hydraulic motor such as the ram 10 in a chosen direction.

Fig. 5 illustrates a preferred form of ram for use with the invention and in particular illustrates the inclusion of the throttle valves 54 in the ram structure. Thus, the ram will be seen to include a ram piston 108 slidably

within the ram cylinder 12 and carried at the inner end of a rod 110 which at its opposite end extends out of the cylinder 12 through an axially bored plug member 112 which simultaneously acts to close the opposite end of the cylinder 12. Each plug member is radially bored to receive a valve seat member threadedly engaged in the radial bore and each valve seat member is formed with axial passage means including a valve seat to co-operate with a valve ball 116, the arrangement being such that the valve ball is unable completely to close the passage circumscribed by the valve seat and leaves a minimum fluid flow path avialable past that seat. The throttle valves respectively communicate with the cylinder spaces in front of and behind the ram piston and each throttle valve is conveniently shaped simultaneously to act as a connection for one of the hydraulic lines 14 or 16 by which the ram operating fluid is delivered from the pump unit 25.

In the arrangement illustrated in Fig. 1, pressure fluid from the pump 25 is delivered through the line 22, valve 18 and line 16 to the hydraulic ram 10 when the ram is to be extended for load-displacing purposes. In order to enable the ram to be displaced to an extent less than the maximum available to it, the invention interposes a hydraulic chamber generally designated 34 in the hydraulic line 14 connected to the cylinder 12 to the rear of the ram. The chamber 34 is shown in more detail in Fig. 2 and comprises a body member 36 formed towards one end with a cylinder 38 wherein is arranged a spring loaded piston 40 normally urged by a spring 42 in a direction towards the inner end of the cylinder 38. The body member 36 is traversed by a port 44 having a branch 46 communicating with the cylinder 38 and an isolating valve 48 which for convenience is shown as being a rotary valve having a diametral port 50 is interposed in the port 44. It will be noted that when the port 50 registers with the port 44 hydraulic fluid is able to flow through the line 14 quite freely and that the spring 42 will urge the piston 40 to the bottom of cylinder 38 as shown in dotted lines in Fig. 2. If the valve 48 is rotated to interrupt the port 44, that is to say if the valve is turned to the position illustrated in Fig. 2, then there is no facility for fluid flow along the line 14 beyond that which is permitted by the volumetric capacity of the displacement cylinder 36 and the resulting pressure of hydraulic fluid will drive the piston 40 towards the outer end of the cylinder 38. Fig. 2 also illustrates diagrammatically the provision of an adjusting screw 52 by which the end position of the piston 40 may be regulated so that, in effect, the stroke then available to the ram is adjustable.

The invention may with advantage be applied to so called cab tilt equipment for raising the driving cabs of commercial vehicles to enable engine and other servicing to be carried out. For this purpose, the ram 10 has a maximum stroke capable of lifting the vehicle cab to a position wherein a major service can be undertaken. However, there are a number of circumstances in which only minor servicing is required and in such cases it is unnecessary for the cab to be tilted to its maximum extent. By employing a displacement chamber 34 as proposed by the present invention, it is possible to adjust the stroke of the piston 40 so that when the port 44 is closed by the valve 48 the ram 10 lifts the cab only to the limited extent required.

In the operation of the device shown in the drawings manual operation of the pump 25, with the valve 18 in the position illustrated in full lines in the drawings, causes pressurized hydraulic fluid to enter the ram cylinder 12 in front of the ram to cause the ram to extend. At the same time hydraulic fluid is displaced from the rear of the piston and through the line 14, valve 18 and line 28 and is returned to the reservoir 30. When the cab is to be lowered, the valve 18 is operated to establish the hydraulic connections indicated by the dotted lines, causing pressurized fluid to pass to the rear side of the ram 10 and to be displaced from in front of the ram through the hydraulic line 16, valve 18 and line 28 to the reservoir. Fluid flow restrictors generally designated 54 and conveniently comprising throttle valves of any convenient type are included in the hydraulic lines 14 and 16 to regulate the movement of the cab once it has passed over dead centre in either direction.

WHAT WE CLAIM IS:—

1. A hydraulic motor arrangement comprising a double-acting hydraulic piston and cylinder device connected by a pair of hydraulic lines to a pump unit, said piston and cylinder device embodying a pair of fluid flow restrictors connected one in each hydraulic line, and a reversing valve integral with the pump unit for directing the flow of hydraulic fluid from the pump unit to the piston and cylinder device through a preselected one of said hydraulic lines.

2. A hydraulic motor arrangement as claimed in claim 1, in which the pump unit has a base formed with a bore wherein is received a rotary valve member of said reversing valve.

3. A hydraulic motor arrangement as claimed in claim 2, in which the bore containing the rotary valve member is forced in a thickened portion of said base.

4. A hydraulic motor arrangement as claimed in claim 2 or claim 3, in which the rotary valve member is provided intermedi-

ate its ends with a pair of circumferentially extending and diametrically opposed recesses adapted selectively to connect the two hydraulic lines to the delivery side of the pump and to a hydraulic reservoir.

5. A hydraulic motor arrangement as claimed in claim 4, in which the hydraulic reservoir is integral with the pump.

6. A hydraulic motor arrangement as claimed in any one of claims 2 to 5, in which the rotary valve member also embodies a pressure relief valve.

7. A hydraulic motor arrangement as claimed in claim 4 and claim 6, in which the rotary valve member has an axial bore formed with a valve seat circumscribing a pressure relief passage communicating with said bore and with one of said recesses and a valve ball resiliently biased against said seat.

8. A hydraulic motor arrangement as claimed in any one of claims 1 to 7, in which one of said hydraulic lines has a branch constituting or connected to a closed hydraulic chamber having a volumetric capacity less than that of said piston and cylinder device and an isolating valve operable to isolate said line and said branch from the remainder of the circuit whereby the extent of movement of said device towards the end position corresponding to the isolated line is limited by the volume of hydraulic fluid that the closed chamber is able to accept.

9. A hydraulic motor arrangement as claimed in claim 8, in which the closed hydraulic chamber has a variable volume thereby enabling the extent of movement of the piston and cylinder device to be preselected.

10. A hydraulic motor arrangement as claimed in claim 9, in which the effective internal volume of said chamber is defined by a movable piston housed therein and adjustment means are provided to enable the end position of the piston in the chamber to be regulated.

11. A hydraulic motor arrangement as claimed in any one of the preceding claims, in which the fluid flow restrictors are arranged one at each end of the piston and cylinder device to which said hydraulic lines are attached.

12. A hydraulic motor arrangement constructed, arranged and adapted to operate substantially as hereinbefore described with reference to and as illustrated in the drawings accompanying the Provisional Specification.

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1352133 PROVISIONAL SPECIFICATION

5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

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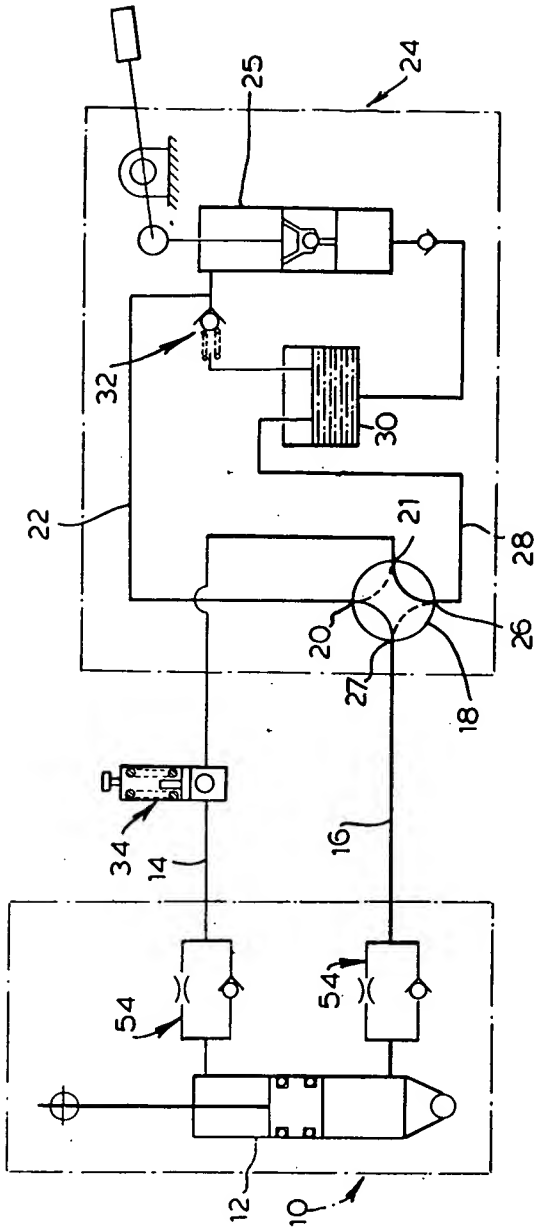


FIG.1.

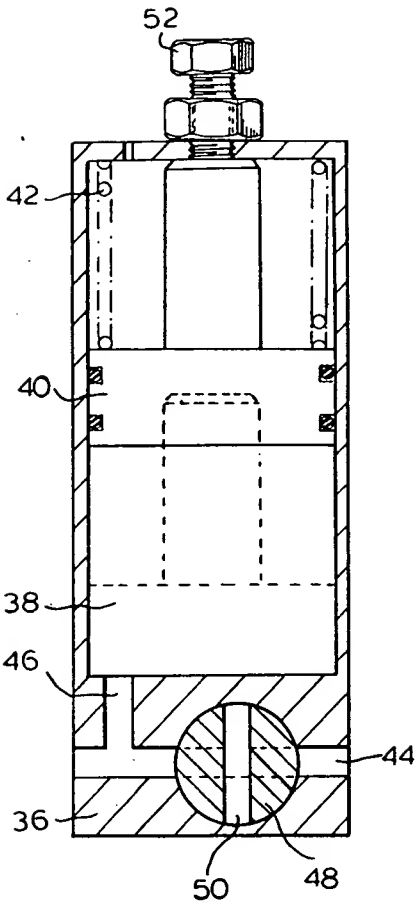


FIG.2.

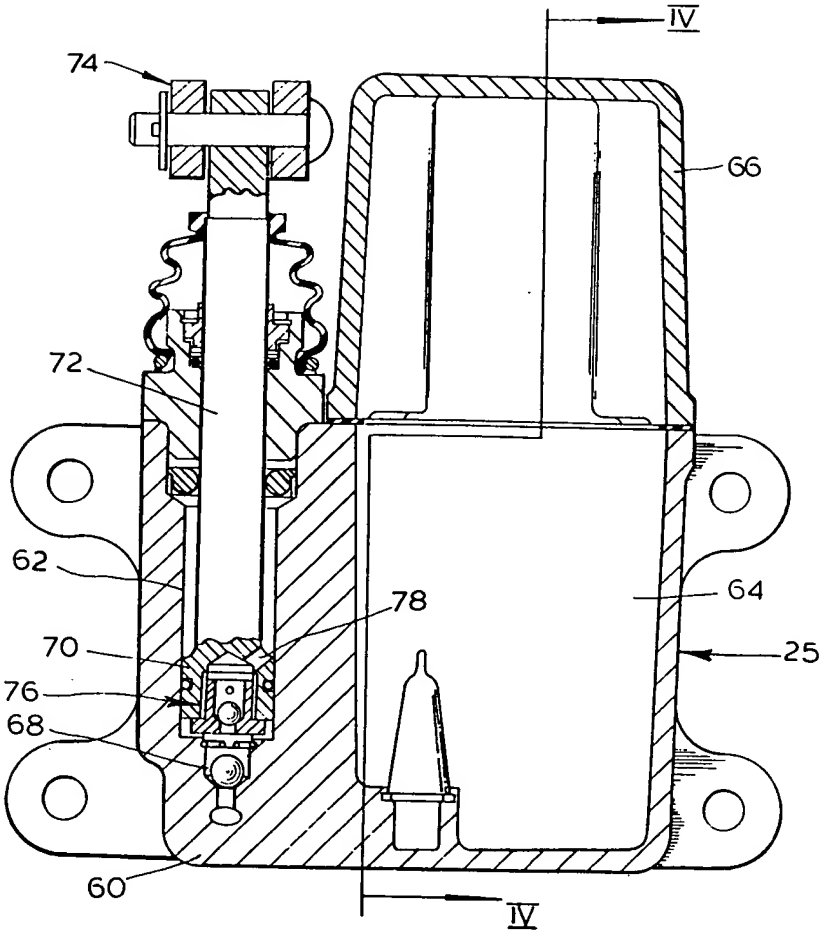


FIG. 3.

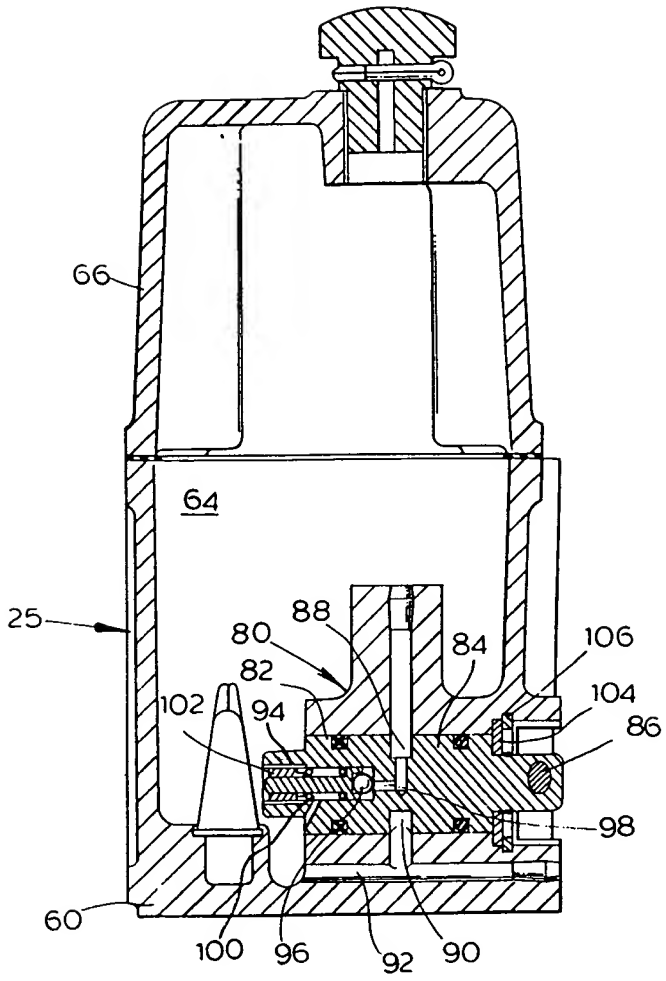


FIG. 4.

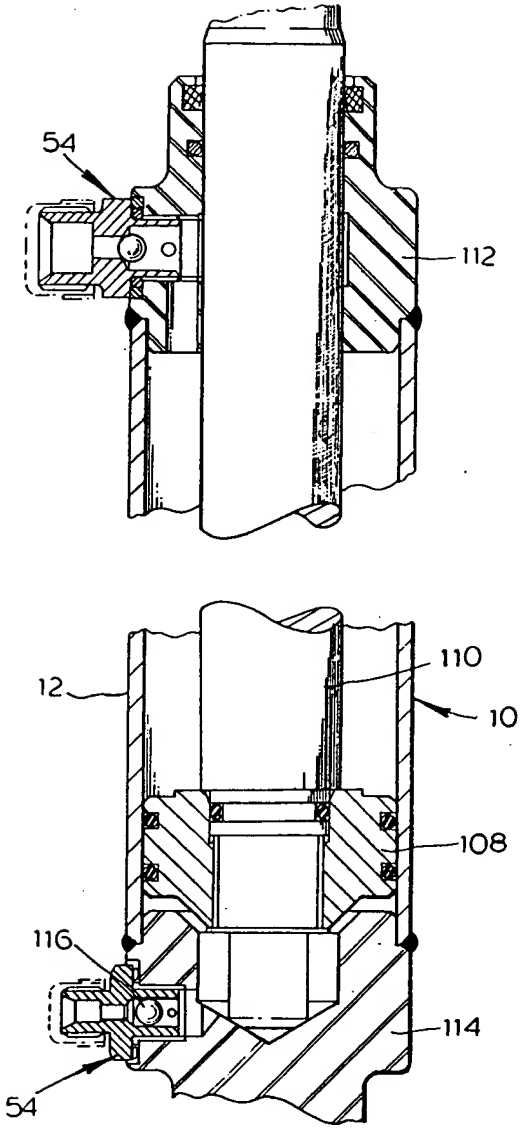


FIG.5.